

NUMERICAL OPTIMISATION

ASSIGNMENT 5

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EXERCISE 1

- (a) Implement the BFGS method by modifying the `descentLineSearch` function. More help is provided inside Cody Coursework.

Submit your solution via Cody Coursework.

[20pt]

- (b) Make your implementation efficient as explained in the lecture i.e. avoid explicitly forming the inverse Hessian matrix H_k . Copy the code lines implementing the update of H_k into your report and briefly explain what makes the implementation efficient.

Submit your solution via Turnitin.

[20pt]

EXERCISE 2

Implement the SR-1 method by modifying the `trustRegion` function. More help is provided inside Cody Coursework. **NOTE:** Here you are not expected to provide an efficient implementation as it would require some changes to `solverCM2dSubspaceExt` which are out of scope at this point.

Submit your solution via Cody Coursework.

[20pt]

EXERCISE 3

- (a) Minimise the function

$$f(x, y) = (x - 3y)^2 + x^4$$

using BFGS (Ex 1a) and SR1 (Ex 2) methods starting from $x_0 = (0, 10)^T$. Compare the performance of the methods. To this end provide any parameters and plots that you consider relevant.

Submit your solution via Turnitin.

[20pt]

- (b) Both implementations return a sequence of matrices as a field of the `info` structure:

- (i) $\{H_k^{\text{BFGS}}\}_{k \geq 0}$ when using BFGS,
(ii) $\{B_k^{\text{SR1}}\}_{k \geq 0}$ when using SR1.

Plot the error of these sequences obtained in **Ex 3a** with respect to the matrices they approximate. In particular, plot

- (i) $\{\|I - H_k^{\text{BFGS}} \nabla^2 f(x_k)\|_2\}_{k \geq 0}$,
(ii) $\{\|B_k^{\text{SR1}} - \nabla^2 f(x_k)\|_2\}_{k \geq 0}$,

and explain your results.

Submit your solution via Turnitin.

[20pt]

Remark. The submission to *Turnitin* should not exceed 4 pages. Avoid submitting code unless explicitly asked for and focus on explaining your results.